IMPROVING THE USE OF MOBILE MEDICAL ALERT DEVICES IN THE ELDERLY

by

John Leo Conway, Jr.

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As members of the DNP Project Committee, we certify that we have read the DNP project prepared by *John Leo Conway, Jr.*, titled *Improving the Use of Mobile Medical Alert Devices in the Elderly* and recommend that it be accepted as fulfilling the DNP project requirement for the Degree of Doctor of Nursing Practice.

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Final approval and acceptance of this DNP project is contingent upon the candidate's submission of the final copies of the DNP project to the Graduate College.

I hereby certify that I have read this DNP project prepared under my direction and recommend that it be accepted as fulfilling the DNP project requirement.

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DEDICATION

To My Wife: My best friend, My companion, My hero.

To My Mom: Without Who’s love & nurturing I would not be.

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ABSTRACT

Background

In relation to falls, 30% of elders experience the danger of an inability to return to get back up (Taylor et al., 2016). This critical period is called a “long-lie,” and can result in catastrophic medical complications such as dehydration, internal bleeding, pressure sores, rhabdomyolysis, or death (Taylor et al., 2016; Lipsitz, Tchall, & Klickstein, 2016). Fall detection devices (FDD) send an alert to summon the assistance of a telephone responder; who notifies family and emergency services to prevent fall from becoming a catastrophe (Feldwiser, 2016).

Purpose

The purpose of this DNP quality improvement (QI) project is to increase the knowledge, attitude, and willingness of residents of an assisted living facility to utilize FDDs.

Design

Eligible participants were given two surveys, one prior to viewing the informational video, and another after viewing the video. The surveys consisted of eight (six point) Likert scale questions ranging from ‘strongly disagree’ to ‘strongly agree.’ The process allowed a descriptive analysis between the survey answers for comparisons of knowledge, attitude and willingness towards wearing FDDs.

Setting

The survey was conducted at a 150 unit assisted living apartment style community called Madison Meadows in Phoenix, Arizona (Appendix B). The residents range from wheelchair dependent to fully functional, but all share similar risks for poor outcomes related to an undetected fall.

Methods

The (QI) project utilizes the power of CAPTology (computes as persuasive technology) to deliver an informational video to change the participants' perceptions from negative to positive regarding FDD use. This may occur without realization; a behavioral modification has occurred.

Limitations

The sample size was limited, allowing bias and decreased generalizability. Some participants were able to discuss survey questions prior to participation. This was a onetime look at one facility. The questionnaires may have been to arduous as some participants needed help to complete the forms.

Results

The greatest common factor surrounding the use of FDD at Madison Meadows is a lack of resident communication. After presenting the informational video, most resident responses reflect positive changes in knowledge attitude and willingness to use the fall detection device.

Conclusion

The greatest common factor surrounding the use of fall detection devices at Madison Meadows is lack of communication, and most specifically resident education. The suggestions of this quality improvement project are to provide education of FDD use at every opportunity.

INTRODUCTION

Telemonitoring (TM) devices include wearable technology such as glucose monitors, blood pressure monitors; and fall detection devices (FDDs) (Ajami & Teimouri, 2015). FDDs identify falls or similar unexpected downward movements and send an alert to a telephone responder; who evaluates the resident's condition then notifies family of the event, and can summon emergency services if needed (Williams, Victor & McCrindle, 2013). This prevents what likely starts as a minor injury ground level fall from becoming a tragic event that could result in unnecessary exacerbated injury or death (Liu, Obermeyer, Chang, & Shanka, 2015).

Background Knowledge

Experiencing an unplanned downward movement is the definition of a fall; and represents a major health risk to the elder population (Taylor-Piliae, Mohler, Najafi, & Coull, 2016). According to Gazibara et al. (2017), 30% of older individuals over the age of 65 fall at least once a year, and 15% fall twice or more. Within that group, 30% of the elderly cannot get up after a fall (Taylor et al., 2016). This critical period is called a "long-lie," and is seen in 30% of elder related falls (Taylor et al., 2016). A long-lie occurs after a fall when an individual is unable to get up and remains on the ground for an extended period of time (Aziz Musngi, Park, Mori, Robinovitch, Park & Robinovitch, 2017). Nyman and Victor (2014) further describe a long-lie as having a fall and then lying on the floor for an hour or more; and associate the fall with serious injury and an increased risk for admission to the hospital, long-term care and death. Potential complications of long-lies include: dehydration, internal bleeding, pressure sores, rhabdomyolysis (Lipsitz, Tchall & Klickstein, 2016). Financial expenditures from "long-lie" related injuries are estimated to cost $34 billion dollars annually and reflect mortality rates exceeding 21,640 deaths per year (Coahran et al., 2018).

One solution to decreasing the incident of complicated long-lie related outcomes rests in the use of FDD technology. Fall detection devices can be activated in two ways. The first way is for the user to push a button on the FDD and intentionally activate the alarm. The second way is for the FDD to sense an unexpected downward movement. This is done by measuring the distance of fall (height), the resting body orientation to the ground, and the velocity of the movement (Koninklijke Philips, 2016). When a fall is detected, and the user remains laying on the ground for a time frame greater than 30 seconds without recovery; the device automatically sends the alert to the life line response center (Koninklijke Philips, 2016). The device directly connects to the *Great Call*® responder who is able to talk to the user in a calm reassuring voice, while summoning assistance (Koninklijke Philips, 2016). The responder then stays in verbal contact with the user unit there is confirmation help has arrived.

Problem Statement

Failure to wear telemonitoring devices such as the FDD is a growing concern for an assisted living community in Phoenix, Arizona. The employees are noticing that residents are not using the FDDs assigned to them. This places the residents at an increased risk for experiencing severe injury due to an undetected fall that results in a high risk “long-lie” experience. Current literature suggests that inconvenience and vanity affect most decisions to not wear the FDDs. Chaudhuri et al. (2014), states device users felt the FDDs were too intrusive. Some did not feel as though they could trigger an alert when needed (Chaudhuri et al., 2017). Others stated, “It feels like, Big Brother is watching too much,” (Chaudhuri et al., 2015). Feldwieser (2016) discovered their subjects thought FDDs were unattractive; were worried the devices would stigmatize them; and that the FDDs made it look like there was something wrong with them. In related studies, most FDD users disliked their appearance stating they were ugly and cumbersome. On a more personal level, subjects noted that the FDDs often fell into embarrassing and inconvenient places, while the users were in public venues (Chaudhuri et al., 2017).

Local Problem

The number of Arizonans age 65 and older is expected to increase by 174% from 883,014 in 2010 to 2,422,186 in 2050 (Arizona Department of Health Services [ADHS], 2014). Conservative estimates suggest that 14% of this population will report motility and health problems requiring the use of special equipment such as a cane, wheelchair, or dependence on a caregiver (ADHS, 2014). More than 30% of Arizona adults age 60 or more have one or more physical disabilities that impair effective self-care (Arizona Department of Economic Security [AZDES], 2010). Within that demographic, 91% require in-home support services (AZDES, 2010). Further, 62% are female, and 52% of all in-home healthcare service residents live alone (AZDES, 2010). These are all demographics that describe a high fall-risk population that is likely to experience a “long-lie” fall experience.

The demographics of this high fall risk population comprises the majority of residents at Madison Meadows, a small retirement and minimal assisted living community in Phoenix, Arizona. As residents age, they become increasingly less mobile, and less stable on their feet. Some are wheelchair dependent. Others require assistive devices to maintain their balance. They cope with increasing debility, and their fall risks are increasing daily. Fall risks in older adults are 40% higher than the fall rates in the general population (Coahran, 2018).

One of the safety devices that Madison Meadows uses is a dual reporting *Great Call*® system or fall detection device (FDD). The FDD summons assistance from on-site staff while also alerting an external telephone *Great Call*® responder. The *Great Call*® responder is able to speak with the resident and determine if assistance is needed. If the responder determines that the resident is not injured the service call is terminated. If conditions met rescue criterium, the responder will summon assistance, including the local fire department if needed. The best practice here is that an intervention is implemented within the golden hour rule, reducing the risks of long-lie experiences. Most importantly, the FDD system decreases the likelihood a minor injury fall will become a life altering catastrophic event (Lipsitz, Tchall & Klickstein, 2016).

The Madison Meadow's facility manger stated many residents refuse to use or even wear the facility provided FDDs. He states that the residents say they do not to wear the device because it is considered unattractive, too much of a burden, or because they simply forget to put it on. This observation reflects some of the information discovered in CIHNAL and Ovid-SD literature databases. Residents do not like the construct of the device, due to looks, its size, or weight and refuse to wear them (Burridge et al., 2018). The manger and staff routinely see the devices connected to wheel chairs and walkers. FDDs connected to mobility devices is problematic especially when the resident falls, but the walker and wheelchair remain upright and still. Without the FDD connected to the resident, there is no rapid downward movement to trigger notification of the telephone responder (Taylor et al., 2016). Another problem is that some residents worry about being too much of a burden. They rarely use the FDD, even after experiencing a long-lie when they had a life-endangering event, because they do not wish to be a burden and would rather not ask for help (Lipsitz, Tchall, & Klickstein, 2016).

Advanced Practice Nurse Significance

The adult acute care geriatric nurse practitioner (ACGNP) as a healthcare provider treats elderly residents in the emergency room and intensive care after the event of a fall related long-lie injury has occurred. Unfortunately, life threatening conditions such as dehydration, pressure sores, and rhabdomyolysis have already begun to take their course (Lipsitz, Tchall, & Klickstein, 2016). Effective medical treatment can be delivered to treat these preventable disease processes, but what if this life-threatening process can be averted before it occurs. This is where the ACGNP's skills as educators and innovators can be utilized to provide education to an at-risk population within the comfort of their residences.

The ACGNP can introduce preventative healthcare interventions such as introducing the FDD as a method for preventing the catastrophic sequalae of an undetected fall, and a subsequent long-lie event. An example of an intervention is an informational video directed at improving the knowledge, understanding and attitudes towards using the FDD. The measurable outcome may be difficult to identify, but the outcome will matter to those who survive potential long-lie events due to the FDD.

Proposed Solution

The concept of CAPTology, (computers as persuasive technology), offers a unique insight on how to administrate the learning process. According to Fogg (2010), digital media surrounds and touches our lives everyday with purposeful elements of persuasion. These persuasive techniques are implemented to influence what we think and what we do, without ever realizing a change in behavior has occurred (Fogg, 2010). In support, Marquis-Faulkes, McKenna, Newell, & Gregor (2005) suggest that filmed scenarios offer a sensory enrichened experience that provide a more robust presentation and is more powerful than words alone. According to Burridge et al. (2017), willingness and a positive attitude are two of the most important factors in assuring a participant's adherence to a therapy. This QI project suggests that a method of improving willingness and a positive attitude is improving knowledge, understanding, and acceptance of wearing the FDD regularly and using it with all falls.

Purpose

The purpose of this DNP quality improvement (QI) project is to increase the knowledge, attitude, and willingness of residents of an assisted living facility to utilize fall detection devices (FDD). The QI project will utilize the power of CAPTology (computers as persuasive technology) to deliver an informational video to subtly modify the resident's attitude and behavior from "reluctance to wear;" "to willing to use." The QI project addresses the unmet educational needs of the residents at Madison Meadows. The short-term outcome of the education is to increase the participants' willingness to wear the FDD. The long-term goal is to prevent a simple fall from becoming a catastrophe.

Aims and Objectives

- Improve the resident's knowledge regarding how the *Great Call*® system can prevent serious injuries due to a fall resulting in a long-lie event.
- Improve the willingness of the residents to regularly wear the *Great Call*® device during all of their activities.
- Improve the attitudes of the residents towards wearing the device

Population and Stakeholders

This QI project focuses on a population of adults: 65 years and older, that have previously fallen and needed assistance to get back up. The stakeholders include the Madison Meadows administrators, employees, the residents and their family members, as well as the *Great Call*® service team. The *Great Call*® company is a third party that offers an extended method for increasing safety and wellbeing by monitoring residents for falls using the FDD. As outsiders looking in, the University of Arizona College of Nursing faculty and DNP student represent investigators looking at a health and safety issue.

Quality Improvement Question

PICO Format

In assisted living residents 65 years or older, who have experienced a long lie fall (P); Will an informational video presentation improve knowledge, attitude and willingness to utilize an FDD (I); Compared to before the informational video (C); Resulting in an increase in wearing the FDD (O).

FRAMEWORK, CONCEPTS AND SYNTHESIS OF EVIDENCE

Theoretical Framework

This QI project for improving attitudes to participate in FDD telemonitoring (TM) requires a theoretical framework that supports the development of knowledge, attitude and willingness. Nilsen (2015) states good theories provide clear explanations of how and why relationships lead to specific events; explain influences of implementation; and provide methods for evaluation. To achieve such goals, the project research process will utilize the Informatics Research Organizing Model (IROM). The IROM model integrates the University of Arizona

College of Nursing's Adaptation of the Academy's Quality Health Outcomes Model with aspects of previously existing nursing informatics models (Effken, 2003).

Framework Description

Grand theories are broad in scope and can focus on a large domain of nursing concepts, further the abstractness will continue to provide a platform on for future development improving knowledge, attitude and willingness for participating in telemonitoring (TM) programs such as the FDD system (Reed, 2011, p. 27). The IROM is a framework that is consistent with grand theory organization that assures a comprehensive assessment of technical interventions and allows middle-range research theories to function easily within its context (Effken, 2003). The IROM consists of a two-component system: an inner ring consisting of a five-phase system called the systems development life cycle (SDLC); and an outer ring consisting of five-constructs (Yen, Bakken, Yen, & Bakken, 2012). Relationships between the constructs can be considered at individual, group, and population levels, and continually evaluated (Effken, 2003) (Figure 1).

Similar to the Institute of Healthcare's: Plan-Do-Study-Act (PDSA) model that provides a worksheet tool to document a test for change (Institute for Healthcare Improvement, 2019); the IROM provides a 360-degree assessment platform to evaluate the use of technology in instructional improvement programs. The IROM also provides guidance to the investigator to consider context of the client, process outcomes and technology involved which promotes ongoing evaluation (Effken, 2003).

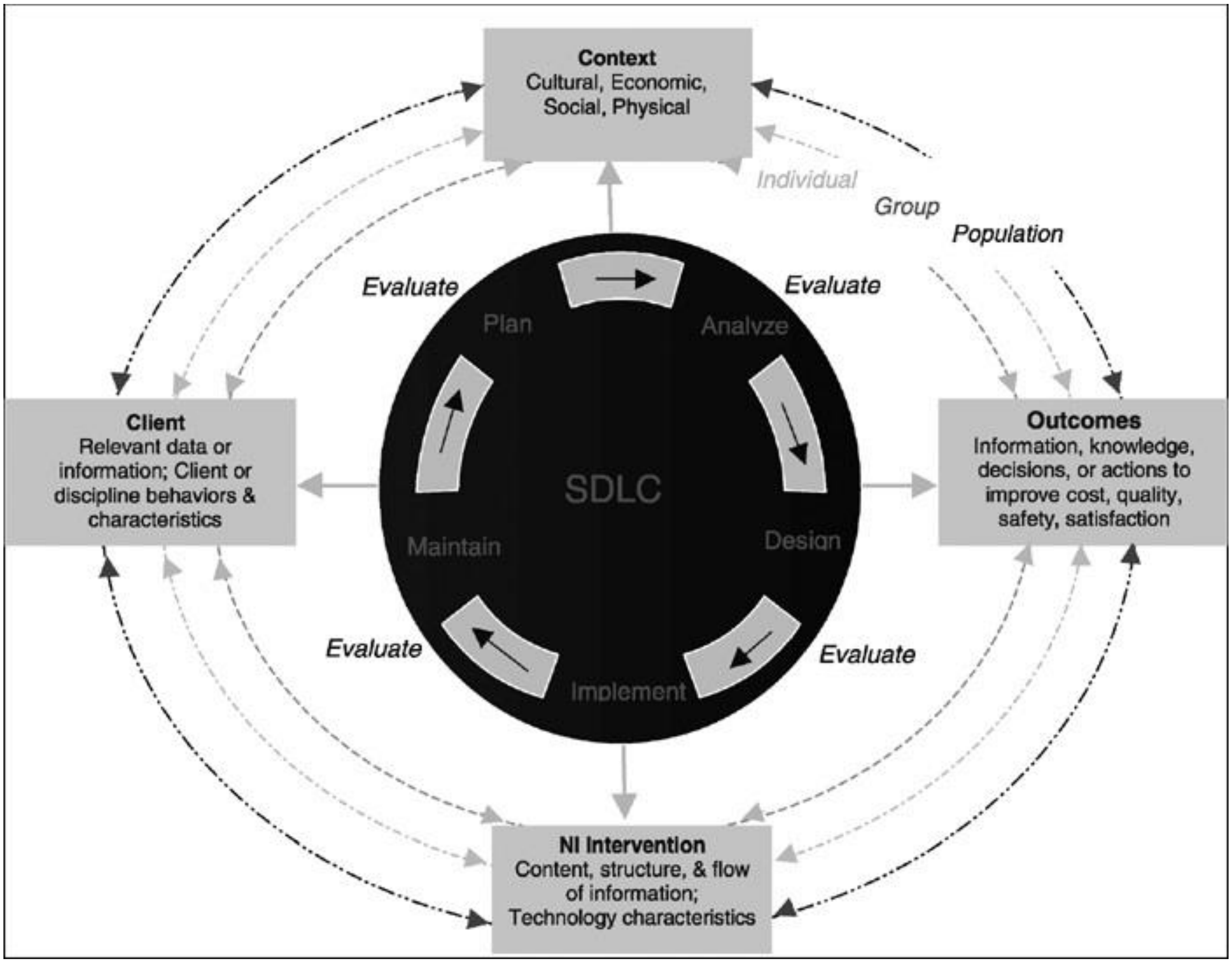


FIGURE 1. Informatics-research-organizing (IRO) model. (Retrieved from Effken, 2009; Research Gate, 2018).

The five-phase SLDC system includes intervention actions of: planning, analysis, design, implementation, and maintenance (Effken, 2003). Planning discovers the scope of the problem and determines solutions, while accounting for available resources and potential outcome benefits: This reflects in the initial contact with the manager at Madison Meadows (Yingjuan & Marion, 2018). Analysis focuses on functional requirements and identifies the needs to assure improvements meet the needs: This represents the need to improve FDD use to increase safety for the residents (Yingjuan & Marion, 2018). Design provides a detailed description of interventions to be utilized to promote and create desired change: This represents developing the informational video, and administering the surveys (Yingjuan & Marion, 2018). Implement refers to the improvement changes introduced to the group: This is actually delivering the QI project intervention: survey-video-survey (Yingjuan & Marion, 2018). Maintenance is the phase when the users fine tune and adjust the process outcomes. If the QI project improves knowledge, attitude and willingness, the video would be shown to new residents at admission, have manufacturer pamphlets available, as well as posting signage reminding residents to use the FDD (Yingjuan & Marion, 2018).

The five-concept constructs of the IROM consist of: context, outcomes, (nursing informatics) intervention, and resident. The constructs are consistent with the nursing metaparadigms: person, environment, health and nursing (Fawcett, 1984). Resident concepts refer to relevant data, information, discipline behaviors or characteristics (Effken, 2003). Context refers to cultural, economic, social, and physical descriptors: Elderly and institutionalized high fall risks) (Effken, 2003). Nursing intervention refers to technology characteristics, content, structure and flow of information (the informational video) (Effken, 2003). Outcomes refer to knowledge, decisions, actions, or improved costs, quality, safety, and -satisfaction (the residents going beyond verbalizing the benefits, but wearing the FDD) (Effken, 2003).

For discovering how personality traits are motivated by CAPTology driven change the constructs in the IROM will be explored from the individual perspective. The strength of the IROM organizing model is its broad applicability to guide research in any setting with any users, any kind of technology application, and any kind of outcome (Effken, 2003). IROM’s chief weakness is a high level of abstraction and requires a process translation similar to those preformed in transversions between grand theories and middle range theories (Effken, 2003). This project will be inclusive of the constructs from the IROM and explore the knowledge, attitude and willingness of a person living with increased fall risks (resident); using telemonitoring fall detection device (intervention); in their private residence (environment); to improve the management of their health (outcome).

Concepts

Lapierre et al. (2018), define a fall as inadvertently coming to rest on the ground, floor or other lower levels, that exclude intentional changes in position to rest in furniture or other objects. Falls and fear of falling present a major risk to older people as both can affect their quality of life and independence (Williams, Victor, & McCrindle, 2013). One of the greatest concerns for independent living communities are undetected falls that result in long-lie occurrences (Lipsitz, Tchall, & Klickstein, 2016). Long-lie falls are associated with increased morbidity and mortality due to persistent functional decline (Taylor et al., 2016). One relatively simple solution is to employ the use of telemonitoring in the form of fall detection devices (FDDs). FDDs are a wearable technology that contain GPS, and gyroscopic sensors that differentiate unexpected downward movements (falls) from normal activity (Williams, Victor, & McCrindle, 2013). The important concept is that the FDD can detect a fall and summon assistance well before a simple fall becomes complicated by a long-lie occurrence.

The greatest challenge to the effectiveness of the FDD system is utilization compliance of the user. Research suggests that the primary causations of this relate to user discomfort with the device being considered unattractive or obtrusive into self-privacy. This QI project focuses on delivering an informational video to improve the participants’ knowledge and attitudes toward the concept and use of the (FDD). CAPTology (computers as persuasive technology) utilizes interactive technology products (computers mobile phones, websites, wireless technologies, mobile applications, and video games) to educate, and subtly influence people's attitudes or behaviors with little awareness of the changing events (Fogg, 2010; Stanford Persuasive Technology Laboratory, 2017).

Synthesis of Evidence

Scoping literature reviews were conducted to yield a preliminary assessment of existing research associated with the effect of CAPTology delivered education to improve resident knowledge, attitude and willingness to participate in telemonitoring processes; specifically, the use of fall detection devices (FDD). Search indexes included: The Cumulative Index of Nursing and Allied Health Literature (CINHAL), Medline-Ovid/SP, PubMed, and Google Scholar. Searches used combinations of the following keywords: CAPTology, persuasive technology, telemonitoring, wearable technology, falls in the elderly, long-lie injury, and fall detection devices. Search limiters included limiting text to English, and restricting publication years only include articles published after 2013. The final selection of 10 founding QI project articles are listed in Table 1 (Evidence Appraisal). The table includes the article, type of study utilized, a synopsis of article findings, and level of evidence (LOE) ratings.

TABLE 1. *Evidence appraisal table.*

Project question: PICO Format: In assisted living residents 65 years or older, who have experienced a long lie fall (P); Will an informational video presentation improve knowledge, attitude and willingness to utilize an FDD (I); Compared to repeated verbal requests to wear them (C); Resulting in an increase in wearing the FDD (O).

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
Borda, A., Gilbert, C., Said, C., Smolenaers, F., Mcgrath, M., & Gray, K. (2018). Non-contact sensor-based falls detection in residential aged care facilities: developing a real-life picture...Health Informatics Conference, Sydney Australia, 2018. *Studies in Health Technology & Informatics*, 25233-38. doi:10.3233/978-1-61499-890-7-33	A principal aim of the present study was to collect and analyze practical implementation data about sensor technologies for falls detection. A secondary objective was to gain an understanding of the feasibility of a non-contact smart sensor system (NCSSS).		Mixed methods approach comprising three phases: Study implementation at a RACF, using a purposive sampling approach; evaluation and poststudy interviews; and analysis and review of results.	The study was conducted in a 170-place RACF with 200 staff. Four male residents (average age 87 years) participated in the pilot study.	The 24/7 'movement monitoring' was enabled with approximately 18GB-25GB of data generated per day/per room. Resulting files averaged 21GB as sensor data blocks comprising high compression files (tar.gz) which were saved to a secure, dedicated server.	The facility staff retained a positive approach towards the project and willingness to participate. Relatives of the residents were also interested, supportive, and helpful throughout the trial; they too could envisage a range of benefits if the technology were proven to work.	LOE: I
Chaudhuri, S., Kneale, L., Le, T., Phelan, E., Rosenberg, D.,	An aim of this study is to understand how clearly older			27 participants (22 female; 5 male) attended focus groups of	Five focus groups at three independent and assisted living	Suggestions provide direction for the design of FDDs in the	LOE:I

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
Thompson, H., & Demiris, G. (2015). Older adults' perceptions of fall detection devices. *Journal of Applied Gerontology*, *36*(8), 915-930. doi:10.1177/0733464815591211	adults perceive or what their perceptions are of current fall detection technologies and their willingness to use such devices.			varied sizes (2, 3, 9, 3, 10) 21 participants were higher socioeconomic class (monthly housing US $2,875-$4,785); 6 were lower socioeconomic class (monthly housing US $506 - $607)	communities were selected to participate. Each focus group followed a script and began with a brief presentation explaining purpose of FDDs and were shown examples. Results identified themes related to two topics of interest.	hopes of increasing appeal and thereby improving use of such devices in the future.	
Chaudhuri, S., Oudejans, D., Thompson, H. J., & Demiris, G. (2015). Real-world accuracy and use of a wearable fall detection device by older adults. *Journal of The American Geriatrics Society*, *63*(11), 2415-2416. doi:10.1111/jgs.13804	To examine the influence of false alarms		A pilot study was conducted to investigate the real-world use and accuracy of a wearable fall detection (FD) device with community-dwelling older adults	18 participants, eight completed the 4-month study; of the 10 who partially completed the study, nine voluntarily left the study, and one was unable to complete because of an injurious fall	To examine the influence of false alarms on adherence, a paired t-test was used to compare adherence 5 days before and after a false alarm. Use of the device 5 days before a fall was also compared with use after the fall (P = .63).	Only one true positive was recorded, when a participant fell backward and hit her head. The largest percentage of false alarms (42.2%) was during normal device use. Another 16.9% of false alarms occurred when the participant dropped the	LOE: I

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
						device. Device misuse and putting the device down each constituted 10.8% of false alarms.	
Chaudhuri, S., Thompson, H., & Demiris, G. (2014). Fall detection devices and their use with older adults: A systematic review. *Journal of Geriatric Physical Therapy*, *37*(4), 178-196. doi:10.1519/JPT.0b013e3182abe779	Systematically assess the current state of design and implementation of fall detection devices.	Systematic review	A systematic literature review was conducted in PubMed, CINAHL, EMBASE and PsycINFO	This review identified 57 projects that used wearable systems and 35 projects using non-wearable systems, regardless of evaluation technique.	Studies were initially divided into those using sensitivity, specificity or accuracy in their evaluation methods, and those using other methods to evaluate their devices. Studies were further classified into wearable devices and non-wearable devices. Studies were appraised for inclusion of older adults in sample and if evaluation included real world settings	Older adults appear to be interested in using such devices although they express concerns over privacy and understanding exactly what the device is doing at specific times.	LOE VI

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
Coahran, M., Hillier, L. M., Van Bussel, L., Black, E., Churchyard, R., Gutmanis, I., & ... Mihailidis, A. (2018). Automated fall detection technology in inpatient geriatric psychiatry: nurses' perceptions and lessons learned. *Canadian Journal on Aging*, *38*(3), 245-260. doi:10.1017/S071498081800018	What are nurses perceptions pf the HELPER system nurses were interviewed regarding their perceptions of this technology. In this study, the HELPER system	Non-randomized methodologies	Qualitative naturalistic inquiry approach in an individual interview	Specialized secured units consist of 55 beds. One of the units focuses on the management of psychological and behavioural symptoms associated with cognitive impairment (25 beds), while the other unit manages a variety of psychiatric illnesses including affective disorders, personality disorders, and schizophrenia (30 beds)	Interviews were conducted over two days at the end of the study time period. Nurses who participated in the study and who were working on the days that the interviews were conducted were invited to participate.	In the current study, the high rate of false alarms reduced nursing staff interest in sustaining the use of this technology. A review of sensor-type systems to prevent falls concluded that high rates of false alarms can desensitize staff to the alarms, thereby reducing their response time to such alarms and act as a barrier to full integration into clinical care.	LOE: V
Feldwieser, F., Marchollek, M., Meis, M., Gietzelt, M., & Steinhagen-Thiessen, E. (2016). Acceptance of	What is the acceptance of automatic fall detection devices as well as the technological commitment and	Framework missing: was part of a larger study	Quantitative dichromtous Pre- and post-study questionnaires were used to assess attitudes and acceptance	In total, 14 subjects with a mean age of 75.1 years completed the study.	A self-developed questionnaire consisting of open and closed questions Pre-and post-study questionnaires	Sensor technology should be as unobtrusive as possible.	LOE: I

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
seniors towards automatic in-home fall detection devices. *Journal of Assistive Technologies, 10*(4), 178-186. doi:10.1108/JAT-07-2015-0021	the health status in community-dwelling adults with a predefined risk of falling?		toward technology.		were used to assess attitudes and acceptance toward technology. Five-item Likert scale, with open questions		
Lapierre, N., N. Neubauer, A. Miguel-Cruz, A. Rios Rincon, L. Liu, and J. Rousseau. 2018. "The state of knowledge on technologies and their use for fall detection: A scoping review." *International Journal of Medical Informatics 111*, 58-71.	To examine the extent and the diversity of current technologies for fall detection in older adults.	Scoping literature review	A scoping review design was used to search peer-reviewed literature on technologies to detect falls	The literature search identified 3202 studies of which 118 were included for analysis. Ten types of technologies were identified ranging from wearable (e.g., inertial sensors) to ambient sensors (e.g., vision sensors).	Data from the studies were analyzed descriptively.	Further research should focus on increasing Technology Readiness Levels of fall detection technologies by testing them in real-life settings with older adults.	LOE IV
Lipsitz, L. A., Tchalla, A. E., Iloputaife, I., Gagnon, M.,	To determine the concordance between falls recorded using an	Observational study	Six-month prospective study	Nursing home residents with a documented history of at least	Healthcare staff reported daily falls, defined as unexpected	Seven of 37 residents whom nursing staff found on the	LOE: I

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
Dole, K., Su, Z. Z., & Klickstein, L. (2016). Evaluation of an automated falls detection device in nursing home residents. *Journal of The American Geriatrics Society*, *64*(2), 365-368. doi:10.1111/jgs.13708	investigational fall detection device and falls reported by nursing staff in a nursing home			one fall within 12 months before consent (N = 62, mean age 86.2 8.1, 66% female).	events in which residents were found on the floor, and the number of these falls was compared with the number of falls recorded according to the device.	floor had a fall recorded according to the device (19%). The device did not identify any of the clinical fall events in 23 of the 37 fallers (62%). The device detected 17 of 89 total falls that nursing staff recorded (sensitivity 19%) within an 8-hour time window. Of 128 fall events that the device recorded, 17 were concordant with nursing reports (13%) within an 8-hour time window, and 111 (87%) were false positives There is poor concordance between falls recorded using the	

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
						investigational fall detection device and falls to the floor that nursing home staff report	
Liu, S. W., Obermeyer, Z., Chang, Y., & Shankar, K. N. (2015). Frequency of ED revisits and death among older adults after a fall. *American Journal of Emergency Medicine*, *33*(8), 1012-1018. doi:10.1016/j.ajem.2015.04.023	Purpose was to examine ED revisits and death after older adult fall patients present to the ED	Retrospective analysis	Analysis of a cohort of patients who presented to the ED	Cohort of patients who presented to the ED of 2 urban, level 1 trauma, teaching hospitals with approximately 80000 to 95000 annual visits+ Patients were eligible if 65 years or olde	We examined the frequency of accumulated ED revisits and death at 3 days, 7 days, 30 days, and 1 year. We defined an event as having at least 1 ED revisit before the specific time (3 days, 7 days, 30 days, and 1 year).	More than one-third of older adult ED fall patients had an ED revisit or died within 1 year. Falls are one of the geriatric syndromes that contribute to frequent ED revisits and death rates. Future research should determine whether falls increase the risk of such outcomes and how to prevent future fall and death.	LOE: II
Taylor-Piliae, R. E., Mohler, M. J., Najafi, B., & Coull, B. M.	Determine the feasibility of using wearable technology	Feasibility study				Stroke survivors mean age was 70 ± 8 years old, were mainly	

TABLE 1 – *Continued*

Author / Article	Research Question	Theoretical Framework	Study Design	Sample & Setting	Data Collection (Instruments)	Findings	L.O.E.
(2016). Objective fall risk detection in stroke - survivors using wearable sensor technology: A feasibility study. *Topics in Stroke Rehabilitation*, *23*(6), 393-399. doi:10.1179/1074935715Z.00000000059	(PAMSys™) to objectively monitor fall risk and gait in home and community settings in stroke survivors.					Caucasian (60%) women (70%), and not significantly different than the age-matched controls (all *P*-values >0.20). Stroke survivors (100%) reported that the device was comfortable to wear, didn't interfere with everyday activities, and were willing to wear it for another 48 hours. The use of in-home wearable technology may prove useful in monitoring fall risk and gait in stroke survivors, potentially enhancing recovery.	

(adapted from Melnyk & Fineout-Overholt's 2011 model).

METHODS

Design

Eligible participants were given two surveys, one prior to viewing the informational video (Appendix D), and another after viewing the video (Appendix E). Each survey consisted of eight questions. The eight 6-point Likert scale questions ranged from: ‘strongly disagree’ (1) to ‘strongly agree’ (6). The pre-informational survey assessed the participants comfort level with the use of FDDs. The post-informational survey revisited the same questions of the pre-survey, after participants completed the informational presentation. This process allowed for a descriptive analysis between prior survey, and post survey scores for comparisons of knowledge, attitude and willingness towards wearing the TDD. The survey questions were adapted from the (Fedwieser, 2016) and (Borda et al., 2018) questionnaire.

Setting

Madison Meadows is a semi-controlled independent senior living environment that uses an FDD monitoring system to increase resident safety. Unfortunately, the system is not being used to its best potential. This QI project was conducted at Madison Meadows which is a 150 unit assisted living apartment style community located in Phoenix, Arizona. Madison Meadows provides housing, a cafeteria style meal service, and housekeeping services. The facility serves retirement age residents from the age of 55 to 90 years of age or more.

Participant Selection

A convenience sampling of 30 participants were utilized for this quality improvement project. Residents who were potential participants were invited during Madison Meadows’ Personal Information Review Fair to update resident emergency information. During the fair flyers were given out for the residents to view. Residents expressing interest were approached and engaged in a brief conversation of the flyer's concepts. If they remained interested, they were invited to voluntarily participate in the QI project.

Interested residents that had been given an FDD device were given a survey prior to seeing the video. Residents who read the disclaimer (Appendix A) and completed the pre-survey (Appendix D), viewed the informational material, and then completed a post survey (Appendix E), became project participants. Participants had the opportunity to opt out at any time, and not complete the project process. Facilitation of the process relied on allowing the participants to answer only the questions they were comfortable with, watch a video (Appendix G) and leave at any moment they wanted (Hoaas et al., 2016).

Approval for this project was obtained from the University of Arizona Institutional Review Board (IRB) (Appendix F) to ensure all required steps and measures were adhered to in the interest of protecting participants, minimizing risk, and safeguarding privacy (Polit & Beck, 2012, p. 165). Participant interviews continued until data saturation is met (Terry, 2015, p. 108). After obtaining human subjects approval from the University of Arizona and gaining the support from stakeholders at Madison Meadows (Appendix B), the project investigator talked with residents at Madison Meadows.

Intervention

The QI project intervention consisted of viewing two brief informational video presentations (Appendix G) developed by Phillips Lifeline, a fall detection device company. The first video is 50 seconds long and gives a brief explanation of how the device works. The second video is four minutes long and describes the risks of a long-lie fall and how a fall detection device intervenes. Intervention Video Link: https://www.greatcall.com/devices/lively-mobile-medical-alert-system. The videos were presented on a large monitor screen powered by laptop computer (Appendix G).

Data Collection

Data collection for this DNP quality improvement project relied on voluntary participation in the QI process after reading all disclosure information (Appendix A). All data were collected in a paper survey. Demographic information (Appendix C) collected asked for: (1) age range (four-year intervals), (2) gender, (3) functional ability (walks, uses device, uses wheelchair), and (4) time in months living in an assisted living environment. Participants were asked to answer an initial survey of and eight item (6 point.) Likert scale questions that ranged from strongly disagree (1 point) to strongly agree (6 points). The questions were as follows:

1. The *Great Call*® device helps me to alert others that I have fallen.
2. The *Great Call*® device is unnecessarily cumbersome
3. The *Great Call*® device is uncomfortable to wear
4. The *Great Call*® device is not sensitive enough to detect falls properly
5. The *Great Call*® device is useful even when it is close enough that I can reach it if I fall
6. The *Great Call*® device is triggered too easily and alerts others unnecessarily
7. The *Great Call*® device is a burden to others who have to respond to the alarms
8. The *Great Call*® device requires extra effort when I go to the bathroom that isn't worth the benefit
9. On average, how many days per week do you wear (on your body) your fall detection device now?

The post-survey included the initial and eight Likert scale questions and asked two more.

- On average, how many days per week do you **plan** to wear (on your body) your fall detection device now?

The two addition (5 point) Likert Scale questions as follows:

- I plan to use my *Great Call*® device as much as possible.
- My understanding of the benefits of *Great Call*® has improved

Participants responses were coded to a subject ID number and entered into a Microsoft® EXCEL® data base (Keller & Kelvin, 2013). During the pre-survey (Appendix D) any disagree level response indicated an opportunity for comparison in the post-survey (Appendix E) to discover the effectiveness of the informational video to improve attitudes in relation to the use of FDD technology.

Process for Data Collection

Resident encounters occurred during the Personal Information Review Fair conducted by Madison Meadows. The pre-survey, delivery of informational material, and post-survey were presented as paper survey in a semi-private room. Administration of the survey, QI project intervention, and data collection was completed on an individually for each participant, if requested to accommodate special needs. At the completion of the QI project process participants were allowed to ask questions and for clarifications of learned information. Once all of the participants completed the process the information was compiled for analysis and the QI project process discontinued.

Data Analysis

The surveys were compared for a change in level of comfort and knowledge, attitude and willingness to participate in the use of the fall detection monitors. A descriptive analysis of pre-intervention responses compared to post-intervention responses was conducted. The analysis compared average scores of each question criteria. The data was analyzed using an Excel spreadsheet and the SPSS system to identify the demographics of participants, and pre-educational knowledge, attitudes, and willingness to use the FDD; in comparison the same attributes after the viewing the informational video (Appendix G). The outcomes of the QI project will indicate if a change in knowledge, attitudes, and awareness will increase the intent to wear the *Great Call*® fall detection device. Follow up investigation will be required to determine if the residents are wearing the FDD on a more regular basis.

Ethical Considerations

Ethics regulations protect human rights, guard intellectual property, and promote integrity in reporting research outcomes (Zaccagnini & Waud-White, 2014, p. 10). The DNP researcher is required to submit investigative project plans to an Institutional Review Board (IRB) (Appendix F) prior to conducting a project that involves participants. The IRB ensures that proposed project plans adhere to federal requirements for ethical research (Moran, Burson, & Conrad, 2017, p. 211). The main tenants for IRB approval include: minimized resident risk, benefits outweigh reasonable risk, an equitable resident selection, obtaining informed consent, vigorous monitoring of resident safety, confidentiality of discovered information, and assuring safeguards effectively protect the rights and welfare of participants (Polit & Beck, 2012, p. 166). This DNP project will utilize three ethical principles; Respect for Persons, Beneficence, and Justice; to develop and implement research tools to assure project methods adhere to IRB requirements.

Respect for Persons

Respect for persons can be very simple if the DNP student remembers that participants are living, breathing, autonomously thinking beings that possess emotions, feel pain, and experience embarrassment. Allowing participants autonomy allows them to make an informed decision about their involvement in the research project, and then choose to enter, or decline to enter the project without coercion (Terry, 2014, p. 62). This project process will occur within a private office space on a completely voluntary basis. Further, informed consent will be adhered to by informing participants that the project is restricted to a questionnaire seeking advice based on personal feelings or thoughts, has no intended intervention, and exerts little or no physical risks. This will allow the participants to understand the project process and make an autonomous decision based on understanding the risks and intentions of the project (Polit &Beck, 2012). The University of Arizona Institutional Review Board's approved informed consent form will be utilized in this process (Appendix F).

Beneficence

Research projects should focus on creating outcomes that benefit the focus population. The DNP project investigator's greatest responsibility was to assure that the project risks were minimized, to prevent harm to avoid malfeasance against the participants (Polit & Beck, 2012, p. 152). The best safe guards focus on "*primum non nocere*" or first do no harm. This means to always act in the best interest of the participant. Always provide participants with protection from harm regardless of the effect on the research project (Terry, 2014, p. 63). Attentive monitoring of every detail experienced by participants, and immediate response to unexpected outcomes, during the project will help to provide barriers to participant injury.

The need for sensitivity is greater in qualitative studies, because it involves in-depth exploration of personal topics (Polit & Beck, 2012, p. 53). Therefore, the DNP investigator must be especially vigilant, anticipate emotional complications, and avoid harming the Resident (Polit & Beck, 2012, p. 153). This DNP project presents a low risk for harm, as discovered information will be coded before the survey is completed, concealing Resident identity.

Justice

Project participants have the right to be treated and understood equally in a harm free supportive environment. The DNP investigator must recruit research participants from multiple groups to assure appropriate coverage of all socio-economic demographics (Terry, 2014, p. 63). Diligent research requires participants be free of conditions that might create an environment in which they might be easily influenced, such as those disadvantaged with severe physical, mental, or economic distress (Terry, 2014, p. 63). Justice also means right to fair treatment which means that researchers must treat people who decline to participate, have non-judgmental manner, must honor all the agreements made with participants, demonstrate respect for participants' beliefs, habits, and lifestyles of people of every background, work, culture, and must always be courteous and tactful at all times (Polit & Beck, 2012, p. 156). Absolute privacy also pertains to justice, as participants have the right for their data to be kept in the strictest of confidence (Polit & Beck, 2012, p. 156).

Human Rights Protection and Consent Process

To protect project participants, human rights protections were instituted, and no data collection occurred until Institutional Review Board (IRB) approval was obtained (Appendix F). Potential participants were identified and agreed to participate through voluntarily contact. During a short discussion, the participants were screened for eligibility and provided information about the project purpose and process, including data collection, analysis, and use of the QI project results. The agreement for participation in the project was then obtained. Before providing the participants with the disclosure form it was reviewed and a verbal agreement to participate was obtained (Appendix A).

The participants had the right to withdraw at any time with no repercussions. Confidentiality was addressed as only the researcher had access to identifying information. The participants were never identified as each information packet was coded with a numerical serial number on all written materials, notes taken, transcriptions, or audiotapes.

Potential for Risk

There were no risks foreseeable to the project participants. If the participant found the interview raised emotional distress when participating in the project process the survey process was terminated.

RESULTS

Participant Selection

This quality improvement project recruited 15 potential participants that showed interest in participating. From the recruited residents, 10 completed the informational education process and both the pre-survey and post-survey. Within this group of 10, five participants met inclusion criteria of having experienced a fall in which they required assistance to get back up (Figure 3). This criterion purposely limited participation to participants who have experienced a fall and been at risk for or had a long lie experience. There were five residents that expressed enthusiasm for the video and volunteered freely to participate in the project. These five participants were residents of Madison Meadows and assigned a fall detection device (FDD).

Participant Demographics

The recruited group consisted of five females and five males. The participant's age ranged from 60 to 80 years of age (Figure 2). The inclusion criteria required participants to have required help to get back up after a fall, which reduced the number of participants to five (Figure 3). The participants' functional ability ranged from five that walked independently, four that used an assistive device, and one required a wheel chair for ambulation (Figure 4). The time the participants resided at Madison Meadows ranged from less than six months to over two years.

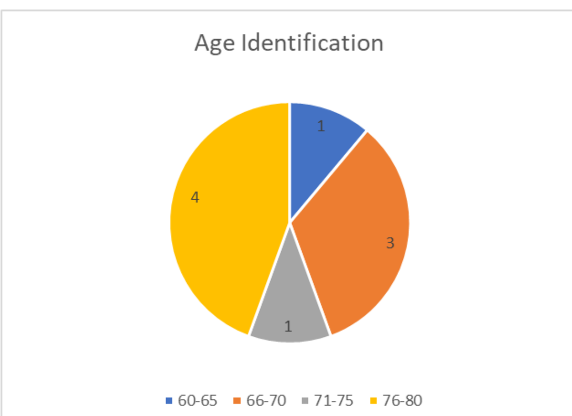


FIGURE 2. Age identification.

The following data tables provide graphic representation of the information discovered during this quality improvement process. Included with each table is a brief synopsis of the question and an interpretation of the discovered information. Questions 1, 5 and 10 are the question that were reverse coded (higher score is positive about device). For all others, the lower the score, the more the participants disagreed with the statement (lower score is positive about device). Most question categories showed a positive improvement in the participant's intent to utilize the FDD, after -having participated in the planned intervention.

FIGURE 3. Fall history.

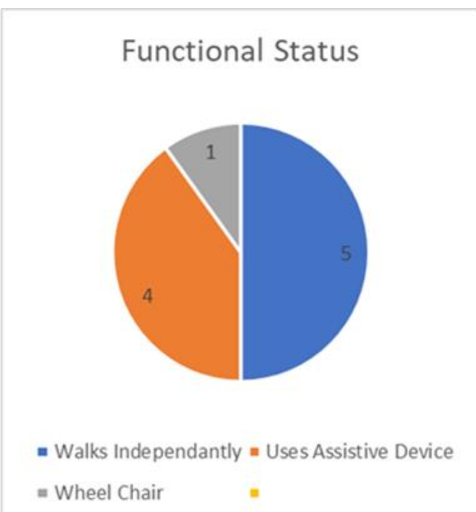


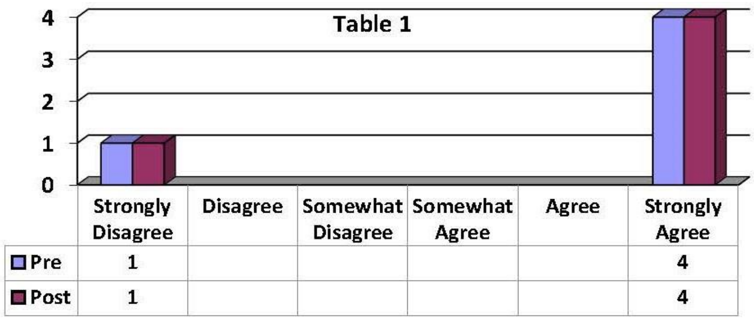
FIGURE 4. Functional status.

Survey Question Data

Question 1

The Great Call® device helps me to alert others that I have fallen. Pre-survey: raw score = 25, *m* = 5; post-survey: raw score: 25, *m* = 5; (Table 2). No change occurred in this category.

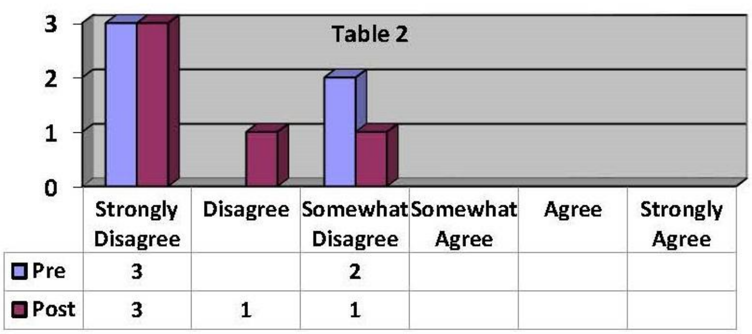
TABLE 2. *Question 1.*



Question 2

The Great Call® device is too uncomfortable to wear. Pre-survey: raw score = 25, *m* = 5; post-survey: raw score: 26, *m* = 5.2; (Table 3). There was a change in this category.

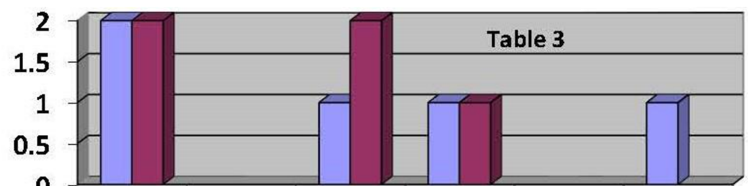
TABLE 3. *Question 2.*



Question 3

The Great Call® device is unnecessarily cumbersome. Pre-survey: raw score = 25, m = 5.2; post-survey: raw score: 12, m = 2.4; (Table 4). There was a change in this category (Table 3).

TABLE 4. *Question 3.*

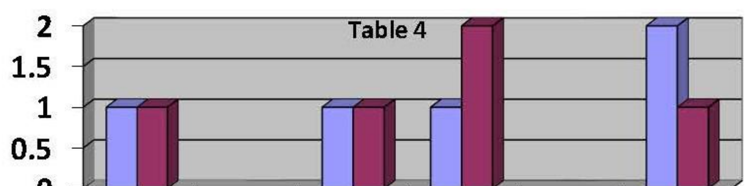


	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
Pre	2		1	1		1
Post	2		2	1		

Question 4

The Great Call® device is not sensitive enough to detect when I fall. Pre-survey: raw score = 20, m = 4; post-survey: raw score: 18, m = 3.6. There was a change in this category (Table 5).

TABLE 5. *Question 4.*

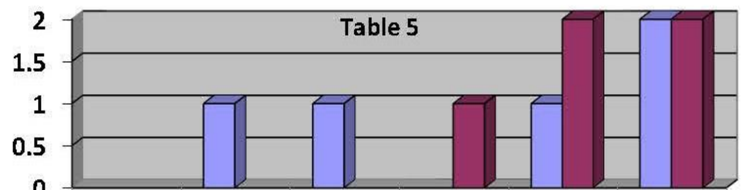


	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
Pre	1		1	1		2
Post	1		1	2		1

Question 5

The Great Call® device is useful if it is close enough that I can reach it if I fall. Pre-survey: raw score = 22, *m* = 4.4; post-survey: raw score: 26; *m* = 5.2. There was a change in this category (Table 6).

TABLE 6. *Question 5.*

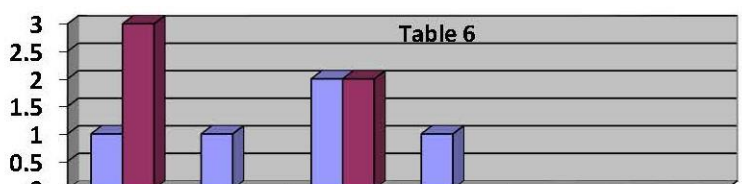


	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
Pre		1	1		1	2
Post				1	2	2

Question 6

The Great Call® device is triggered too easily and sends unnecessary alerts. Pre-survey: raw score = 13, *m* = 2.6; post-survey: raw score: 9; *m* = 1.8. There was a change in this category (Table 7).

TABLE 7. *Question 6.*

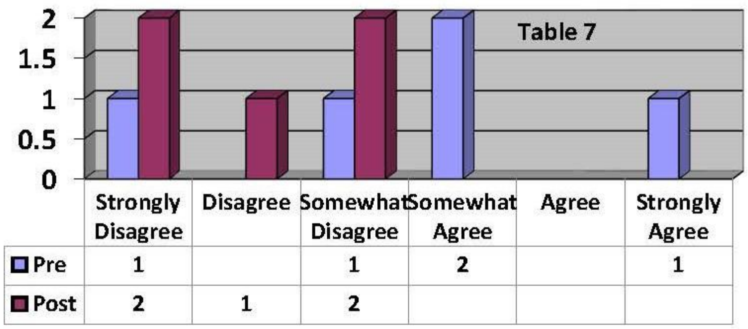


	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
Pre	1	1	2	1		
Post	3		2			

Question 7

The Great Call® device is a burden to others who have to respond to the alarms. Pre-survey: raw score = 18, *m* = 3.6; post-survey: raw score: 10; *m* = 2. There was a change in this category (Table 8).

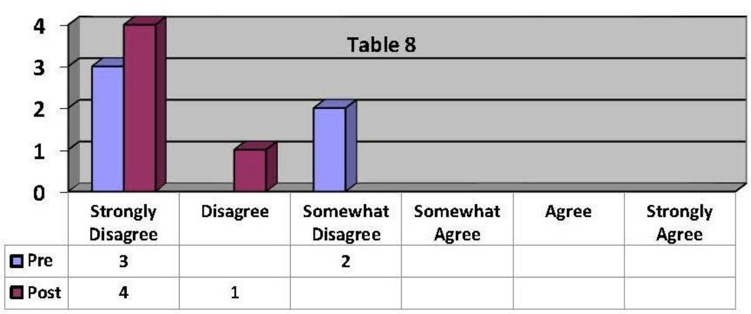
TABLE 8. *Question 7.*



Question 8

The Great Call® device is bothersome when I go to the bathroom and is not worth the benefit. Pre-survey: raw score = 9, *m* = 1.8; post-survey: raw score: 6; *m* = 1.2. There was a change in this category (Table 9).

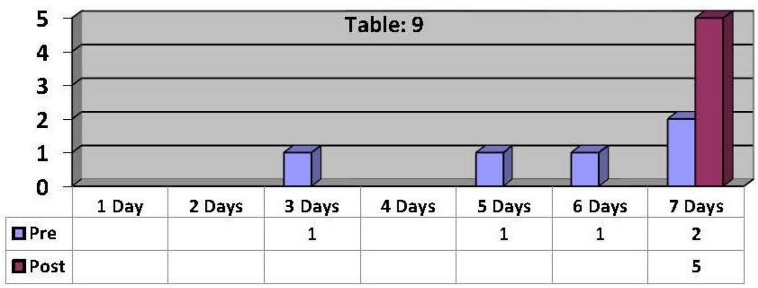
TABLE 9. *Question 8.*



Question 9

Intent to use (Days per week). Pre-survey: raw score = 28, *m* = 5.6; post-survey: raw score: 35; *m* = 7. There was a change in this category (Table 10).

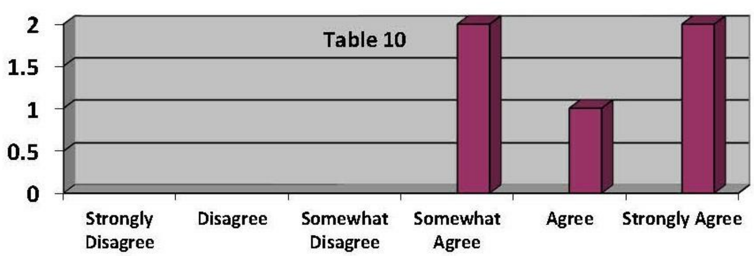
TABLE 10. *Question 9.*



Question 10

I plan to wear and use my Great Call® device as much as possible. Post-survey: raw score: 25; *m* = 5, (Table 11).

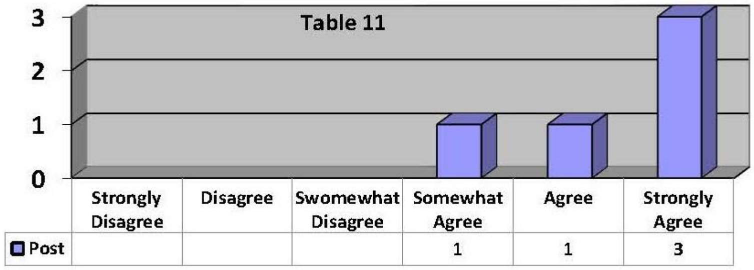
TABLE 11. *Question 10.*



Question 11 (Post-Intervention Only)

My understanding of the benefits of the Great Call® system has improved. Post-Intervention Question: Resident (1): strongly agreed. Resident (2): strongly agreed. Resident (3): somewhat agreed. Resident (4): agreed. Resident (5): somewhat agreed. Post-survey: raw score: 27; *m* = 5.4 (Table 12).

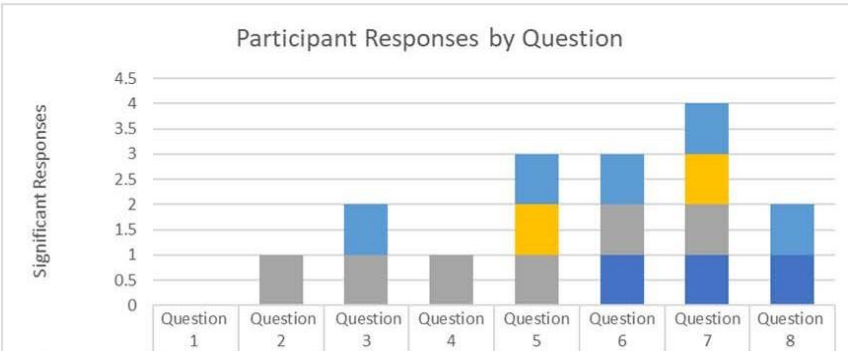
TABLE 12. *Question 11.*



Data Discovery by Question

Question 1: reflected no change in the confidence of the FDD to alert others a fall has occurred. Question 2: reflected an improvement in willingness to wear the FDD using alternate methods, such as on a wrist band. Question: 3 reflected positive changes in participants (3) and (5). Question 4: reflected a positive change in Resident (3). Question 5: reflected positive changes in participants (3,4, and 5). Question 6: reflected positive changes in participants (1,3, and 5). Question 7: reflected positive changes in participants (1, 3,4, and 5), while reflecting the most positive changes overall. Question 8: reflected positive changes in participants (1, and 5). Resident (3) reflected the most positive changes. Resident (2) reflected no changes on all questions (Table 13).

TABLE 13. *Resident responses by question.*



	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
Partipant 5			1		1	1	1	1
Participant 4					1		1	
Participant 3		1	1	1	1	1	1	
Participant 2								
Participant 1						1	1	1

DISCUSSION

The intent of this quality improvement project was to increase the use of FDDs; and reduce unnecessary injuries related to falls with long-lie experiences. The improvement intervention included viewing an instructional video that detailed the functional use of the FDD. The participants completed surveys before and after viewing the video. Responses were compared to identify if the intervention improved the knowledge, attitude and willingness of the participants to use their FDDs. In addition to surveys, visual observations were made at one month and again at two-month intervals, during follow up meetings with the Madison Meadows facility with manager, to confirm improvement in FDD use.

Human Factors (Ergonomics)

The most common discoveries focused on the ease and comfort of use related to how the fall detection device functions and is utilized. Dennerlein (2015) states that when users adopt use of mobile technology, general designs should provide as much comfort in usability as possible. With respect to design requirements, Fletcher and Jensen (2015) suggest that technology must accommodate user needs such as ease of use. Toh, Pawlovich and Gzrybowski (2016) state that users should be provided with choices such as adaptability to hand dominance, or in the case of the FDD within the scope of this project, how the technology is worn. Laxman, Banu Krishnan and Dhillion (2015) state the technology should be simple and intuitive and eliminate unnecessary complexity. The general concept is that it is the responsibility of the device designer to met the needs of the user, and is not always the user's responsibility to adapt to unitary designs in technology.

Education Factors

Education needs presented as a common need for participants in this project. The participants reported they were given the device with no instruction on use. In this case the responsibility of the provider (the care facility) failed in their efforts to deliver education and resultantly created the condition for improper or non-use of the fall detection device. Yildiz et al. (2018), state that clients who receive a constructed patient education intervention, achieve faster adaptation to daily life and decreased misinformation and misperceptions. Huber and Watson (2014) state that research on technology and ways of teaching technological skills that support aging should be at the forefront. Therefore, it is a primary responsibility for the care provider to deliver proper educational processes to clients on a regular basis, and help bridge the gap between device design, and how their clients utilize technology.

Data Discovery by Participant

Question 1

The single disagree entry occurred in *Participant 4*, a male of 81-85 years, who uses a cane. The lack of a change indicates a neutral or non-effective outcome for the intervention, as all other participants strongly agreed (Table 2).

Question 2

Participant 1 remained unchanged at strongly disagree. *Participant 2* remained unchanged at strongly disagree. *Participant 3* changed from disagree to strongly disagree. *Participant 4* was unchanged, at somewhat disagree. *Participant 5* was unchanged at somewhat disagree. The trend towards strongly disagree indicates improved acceptance for wearing the FDD as a pendant; or by provided alternative methods, a positive intervention outcome (Table 3).

Question 3

Participant 2 remained unchanged at strongly disagree. *Participant* 3 changed from strongly agree to disagree. *Participant 4* remained unchanged at somewhat disagree. *Participant 5* somewhat agree to somewhat disagree. The trend towards strongly disagree indicates an increased acceptance of the FDDs physical characteristics and is a positive intervention outcome (Table 4).

Question 4

Participant 1 remained unchanged at strongly agree. *Participant 2* remained unchanged at strongly disagree. *Participant 3* changed from strongly agree to somewhat agree. *Participant 4* unchanged at somewhat agree. *Participant 5* remained unchanged at somewhat agree. The trend from strongly agree towards strongly disagree indicates increased confidence in the FDD to detect a fall, a positive intervention outcome (Table 5).

Question 5

Participant 1 remained unchanged at strongly agree. *Participant 2* remained unchanged at strongly agree. *Participant 3* changed from somewhat agree to agree. *Participant 4* changed from somewhat disagree to agree. *Participant 5* changed from disagree to agree. The trend from strongly disagree to strongly agree, and indicates understanding the FDD must be within reach to be optimally effective, a positive intervention outcome (Table 6).

Question 6

Participant 1 changed from somewhat disagree to strongly disagree. *Participant 2* remained unchanged at strongly disagree. *Participant 3* changed from strongly disagree to disagree. *Participant 4* remained unchanged at somewhat disagree. *Participant 5* changed from disagree to somewhat disagree; he trended towards strongly disagree suggests greater comfort for understanding the benefits for the FDD to detect and report falls, a positive intervention outcome (Table 7).

Question 7

Participant 1 changed from strongly to somewhat disagree. *Participant 2* remained unchanged at strongly disagree. *Participant 3* changed from strongly agree to somewhat disagree. *Participant 4* changed from somewhat disagree to strongly disagree. *Participant 5* Changed from somewhat agree to disagree. The trend towards strongly disagree reflects understanding responding to the FDD is not a burden that others must manage a positive intervention outcome (Table 8).

Question 8

Participant 1 changed from somewhat disagree to strongly disagree. *Participant 2* remained unchanged at strongly disagree. *Participant 3* remained unchanged at strongly disagree. *Participant 4* remained unchanged at strongly disagree. *Participant 5* changed from somewhat agree to disagree. The trend to strongly disagree shows an understanding the importance of using the FDD at all times, a positive intervention outcome (Table 9).

Question 9

Participant 1 presented no change (7 to 7 days) weekly. *Participant 2* presented no change (7 to 7 days) weekly. *Participant 3* presented a positive change (from 3 days to 7 days) weekly. *Participant 4* presented a change (from 5 to 7 days) weekly. *Participant 5* presented a positive change (from 6 to 7 days) weekly. This is an indication of intervention success to increases FDD use (Table 10).

Question 10

Participant 1 'strongly agreed.' *Participant 2* 'strongly agreed.' *Participant 3* 'strongly agreed.' *Participant 4* 'agreed.' *Participant 5* 'somewhat agreed.' This is an indication of intervention success to increase FDD use (Table 11).

Question 11

Post-intervention question: *Participant 1* 'strongly agreed.' *Participant 2* 'strongly agreed.' *Participant 3* 'somewhat agreed.' *Participant 4* 'agreed.' *Participant 5* 'somewhat agreed.' This is an indication of intervention success to increase understanding FDD use (Table 12).

Question Data by Content

Question 2 and question 3 focused on the FDD being too uncomfortable and cumbersome to wear. The current problem at Madison Meadows is that the residents were exposed only to a lanyard when becoming a resident. This limited the residents to wearing the devices around the neck like a pendant. It was described as heavy, cumbersome and annoying. The video showed alternative methods such as a belt clip and wristband that were also available as methods for wearing the device. At the meetings, the facility manager stated residents have been visualized wearing the FDD on belt clips or the wristband; and use has appeared to have increased use, or at least the device is more visible now.

Question 4 focused on the FDD being sensitive enough to detect falls. The residents had little understanding about the internal working of the FDD. They were unaware that the device had to be worn directly on the body to detect the elements that trigger a fall alert. The informational video described the elements in detail and stated repeatedly that the device must be worn as much as possible to detect a fall event. The survey response reflects a slight change towards agreeing the FDD device will detect a fall. At the meetings, the facility manager stated that observations of the residents reveal an increase in the FDD being attached to the residents' body, and not attached to their walkers, wheelchairs, or to a purse.

Question 5 and question 8, focused on the proximity of the FDD. Much like the lack of knowledge that the device must be worn, there was a similar lack of knowledge that the FDD needed to be within reach during hours of sleep. The informational video expressed this need to the participants. The survey responses indicated a shift towards understanding that the FDD should be close to their beds at night. After a follow up discussion with the available participants, self-reports indicated some had relocated the charging bases and FDDs closer to their beds.

Question 6 and question 7, focused on a fear that the FDD is triggered too easily and sends unnecessary alerts. Most residents expressed a concern for embarrassment for a triggered fall response, especially when assistance was not needed. After viewing the informational video; participants understood that a 24-hour responder employed by *Great Call®* was the first respondent, and that after evaluating their condition; the responder would summon the appropriate help such as 911 emergency services. The surveys revealed a trend towards greater comfort with an automated alert.

In follow up discovery process, the participants expressed greater comfort with the FDD system. One participant related that an automated alarm signaled the on-duty responder, she had fallen in the shower, and was subsequently rescued from a possible long-lie event or serious injury from a second fall. In the follow up discovery process, the facility manager related that there were two additional rescues based on increased use of the FDD.

Limitations

This project had limitations. The sample size was limited, allowing bias due to the low number of participants. The participants were recruited for random residents. and were able to discuss the survey questions in a “gossip-like” format prior to participating quality improvement process, introducing additional bias to the process. This was also a onetime look at one facility, decreasing the population size, and the sample size more. The surveys were “too difficult” in places and some participants needed help to complete the forms.

Resources and Timeline

The timeframe for this project was from: 10/01/2018 to 10/02/2018 during which two sessions were held just prior to lunch service, and immediately afterwards. Each participant encounter took approximately 20 minutes from start to finish. The total cost of the QI project was $50 for clerical supplies, $20 for a miscellaneous candy bowl reward for participation, and less than $20 for travel (Appendix H).

Lessons Learned

This was the first implementation of this QI project. All participants were previously aware of the risks of falls. In some cases, the participants were unaware of the risks associated with long-lie falls. In many cases detailed instructional follow up discussions were required to fully address extended participant questions. Futuristically I would allow more time for follow up discussion to better meet the needs of the participants. I would also decrease the complexity of surveys.

Conclusion

The greatest common factor surrounding the use of fall detection devices at Madison Meadows is lack of communication, and most specifically resident education. The participants stated that they were handed a box with the FDD inside and told to wear it. No other instructions were provided. The participants did not read the instructions beyond the basics of how to activate and charge the device. They became complacent in wearing the devices. Interestingly the most difficult participant that presented with no changes in outlook, suggested that Madison Meadows should present the video to residents when the device is provided.

Therefore, the suggestions of this quality improvement project are as follows: (1) provide access to the informational video when residents move into the facility; (2) provide biannual reeducation on the use of the FDD; (3) use the opportunity of device maintenance as a chance to reeducate residents; (4) have staff randomly ask residents about how well their FDDs are working, and report discovered concerns to management once discovered; and, (5) consider providing residents an intrinsic reward such as a free trip to the beauty parlor based on being seen wearing the FDD.

Concluding, the benefits of the FDD improves the quality of life by improving the user’s autonomy while safe guarding their wellbeing. The FFD can summon assistance in the event of an unexpected fall that results in a “long-lay” experience and prevent serious injury or death. The greatest challenge is maintaining motivation to use the FDD and should be the focus of additional studies surrounding the challenges of its use.

APPENDIX A:

DISCLOSURE AND DETERMINATION STATEMENT

IMPROVING THE USE OF MOBILE MEDICAL ALERT DEVICES IN THE ELDERLY

John Conway, RN, MSN Ed., CCRN, DNPc

The purpose of this DNP project is to discover if an informational video will increase resident knowledge, attitude and willingness to wear a *Great Call*® or similar fall detection device system.

If you choose to take part in this project, you will be asked to answer 8 questions asking your degree of agreement ranging from: strongly disagree to strongly agree about questions pertaining to acceptance of the fall detection system. The videos last about 7 minutes, and the surveys take about 5 minutes to complete. There are no foreseeable risks associated with participating in this project and you will receive no immediate benefit from your participation. Survey responses are anonymous and used a number code and identify resident response(s).

If you choose to participate in the project, participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw at any time from the project. In addition, you may skip any question that you choose not to answer. By participating, you do not give up any personal legal rights you may have as a resident in this project.

For questions, concerns, or complaints about the project, you may call: John Conway. At 602-989-4806 or send an Email to: jconway1@email.arizona.edu. Thank you for your assistance in this effort.

APPENDIX B:

LETTER OF PERMISSION TO USE FACILITY

Madison Meadows
7211 N 7th St
Phoenix, AZ 85020
602-737-2703

Date: October 15, 2018

University of Arizona Institutional Review Board
c/o Office of Human Subjects
1618 E Helen St
Tucson, AZ 85721

Please note that John Conway, U of A Doctor of Nursing Practice student, has permission of the Madison Meadows Retirement Community to conduct a quality improvement project at our facility for his project: Improving the Use of Mobile Medical Alert Devices in the Elderly.

Mr. Conway will conduct a survey of clients at Madison Meadows. He will contact clients during a Safety Awareness Fair. Contact will be facilitated by announcement in the Madison Meadows monthly newsletter to draw interest to participate in the project. Clients will be given the opportunity to decline participation or accept participation in the quality improvement process.

Clients wishing to participate will be asked to answer pre-survey questions, then watch an informational video, and finally take a similar post-survey questionnaire. The process will determine if the informational video improved the resident's intent to wear their Great Call® Mobile Medical Alert Device. Mr. Conway's activities will be completed by December 30, 2018.

Mr. Conway has agreed to provide to the Madison Meadows office a copy of the University of Arizona Institutional Review Board Determination before he recruits participants. He will also will present aggregate results at their monthly staff meeting.

If there are any questions, please contact my office.

Signed:

Bill Blackerby
General Manager.

HOLIDAY
RETIREMENT

Bill Blackerby
General Manager
william.blackerby@holidaytouch.com
7211 N 7th St
Phoenix, AZ 85020
Office 602.944.4222

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APPENDIX C:

INTERVENTION DEMOGRAPHIC SURVEY

Intervention Demographic Survey
Please circle the answer that you choose

Gender: Male Female Refuse to Identify

Age: Under 60 years 60-65 years 66-70 years 71-75 years 76-80 years

81-85 years

How long have you lived at Madison Meadows? Less than 6 months. 6 months – 12 months

12-18 months 19-24 months Longer than 24 months

What is your functional Status: Walk independently Use a cane or walker

Use a Wheelchair

Have you ever fallen down? Yes No

Did you need help to get back up?..

Yes ....

No

APPENDIX D:

PRE-INTERVENTION SURVEY

Pre-Intervention Survey

Please circle the answer that you choose

1. The *Great Call* ® device helps me to alert others that I have fallen.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

2. The *Great Call* ® device is too uncomfortable to wear.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

3. The *Great Call* ® device is unnecessarily cumbersome.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

4. The *Great Call* ® device is not sensitive enough to detect when I fall.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

5. The *Great Call* ® device is useful even when it is close enough that I can reach it if I fall.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

6. The *Great Call* ® device is triggered too easily and sends unnecessary alerts.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

7. The *Great Call* ® device is a burden to others who have to respond to the alarms.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

8. The *Great Call* ® device is bothersome when I go to the bathroom and is not worth the benefit.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

9. How many days per week do you wear (on your body) your fall detection device now?

1 2 3 4 5 6 7

APPENDIX E:

POST-INTERVENTION SURVEY

Post-Intervention Survey
Please circle the answer that you choose

1. The *Great Call* ® device helps me to alert others that I have fallen.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

2. The *Great Call* ® device is too uncomfortable to wear as a pendant hanging from the neck.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

3. The *Great Call* ® device is unnecessarily cumbersome.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

4. The *Great Call* ® device is not sensitive enough to detect when I fall.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

5. The *Great Call* ® device is useful even when it is close enough that I can reach it if I fall.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

6. The *Great Call* ® device is triggered too easily and sends unnecessary alerts.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

7. The *Great Call* ® device is a burden to others who have to respond to the alarms.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

8. The *Great Call* ® device is bothersome when I use the bathroom and is not worth the benefit.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

9. How many days per week do you plan to wear (on your body) your fall detection device now?

1 2 3 4 5 6 7

10. My understanding of the benefits of the *Great Call* ® System has improved.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

11. I plan to wear and use my *Great Call* ® device as much as possible.

Strongly Disagree Somewhat Disagree Disagree Somewhat Agree Agree Strongly Agree

APPENDIX F:

THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL LETTER

THE UNIVERSITY OF ARIZONA
Research, Discovery & Innovation

Human Subjects Protection Program

1618 E. Helen St.
P.O.Box 245137
Tucson, AZ 85724-5137
Tel: (520) 626-6721
http://rgw.arizona.edu/compliance/home

Date:	November 09, 2018
Principal Investigator:	John Leo Conway
Protocol Number:	1811070440
Protocol Title:	IMPROVING THE USE OF MOBILE MEDICAL ALERT DEVICES IN THE ELDERLY
Determination:	Human Subjects Review not Required

Documents Reviewed Concurrently:

Data Collection Tools: *2018 IMPROVING THE USE OF MOBILE MEDICAL ALERT DEVICES videos.pptx*
Data Collection Tools: *Demographic Survey.docx*
Data Collection Tools: *Postintervention survey.docx*
Data Collection Tools: *Preintervention survey.docx*
HSPP Forms/Correspondence: *2018 determination_2-3_v2018_4 conway john 11 06 2018 (5).pdf*
HSPP Forms/Correspondence: *Advisor Confirmation Email.pdf*
Informed Consent/PHI Forms: *Conway Disclosure Statement.docx*
Other Approvals and Authorizations: *2018 Oct-15 Madison Meadows Permission Conway John.pdf*
Recruitment Material: *2018 Great Call Device Flyer.docx*

Regulatory Determinations/Comments:

- Not Research as defined by 45 CFR 46.102(d): As presented, the activities described above do not meet the definition of research cited in the regulations issued by U.S. Department of Health and Human Services which state that "research means a systematic investigation, including research development, testing and evaluation, designed to contribute to generalizable knowledge."

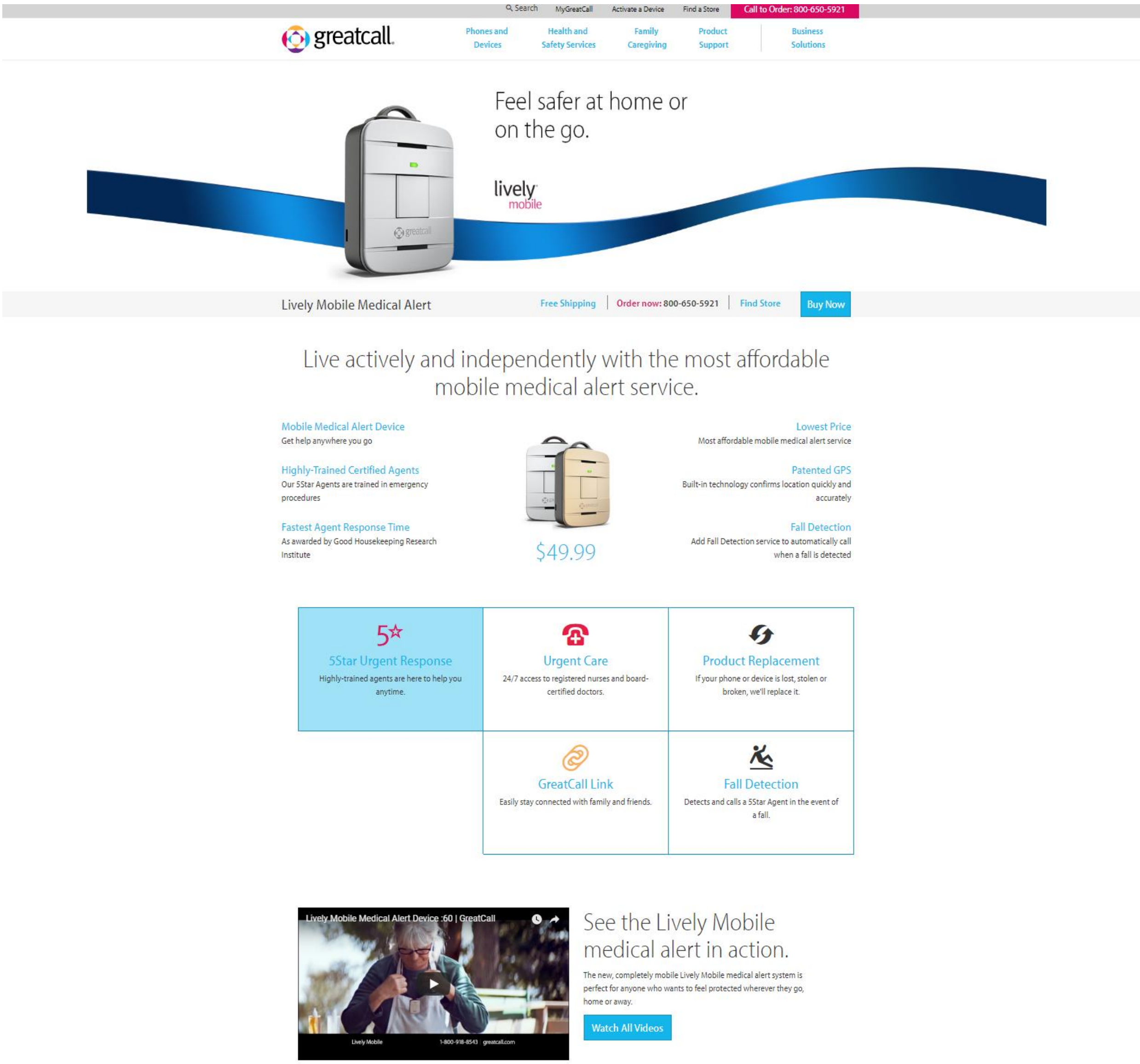
The project listed above does not require oversight by the University of Arizona.

If the nature of the project changes, submit a new determination form to the Human Subjects Protection Program (HSPP) for reassessment. Changes include addition of research with children, specimen collection, participant observation, prospective collection of data when the study was previously retrospective in nature, and broadening the scope or nature of the study activity. Please contact the HSPP to consult on whether the proposed changes need further review.

The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).

APPENDIX G:

GREAT CALL® MEDICAL ALERT DEVICE INFORMATIONAL VIDEO SITE



Retrieved from: https://www.greatcall.com/devices/lively-mobile-medical-alert-system

APPENDIX H:

PROJECTED BUDGET

Projected Budget	
Expense Items	**Estimated Expense**
Travel	$20.00
Operations	$10.00
Materials and Supplies (Snacks, Paper)	$10.00
Printing/Marketing (Fliers)	$10.00
Miscellaneous	$10.00
Total Estimation of Expenses	$60.00

REFERENCES

Ajami, S. & Teimouri, F. (2015). Features and application of wearable biosensors in medical care. *Journal of Research in Medical Sciences, 20*(12), 1208-1215. doi:10.4103/1735-1995.172991

Aziz, O., Musngi, M., Park, E., Mori, G., Robinovitch, S., Park, E. J., & Robinovitch, S. N. (2017). A comparison of accuracy of fall detection algorithms (threshold-based vs. machine learning) using waist-mounted tri-axial accelerometer signals from a comprehensive set of falls and non-fall trials. *Medical & Biological Engineering & Computing*, *55*(1), 45-55. https://doi-org.ezproxy1.library.arizona.edu/10.1007/s11517-016-1504-y

Arizona Department of Economic Security. (2010). *Division of aging and adult services Arizona state plan on aging federal fiscal years 2011–2014 (October 1, 2010–September 30, 2014).* State of Arizona Department of Economic Security Division of Aging and Adult Services. Retrieved May 1, 2018 from https://des.az.gov/sites/default/files/dl/Aging_State_Plan_2011_2014.pdf

Arizona Department of Health Services. (2014). *Aging in Arizona; health status of older Arizonans: Bureau of public health statistics.* The Bureau of Public Health Statistics

Arizona Department of Health Services. Retrieved May 1, 2018 from http://pub.azdhs.gov/health-stats/report/aging/aia-report.pdf

Borda, A., Gilbert, C., Said, C., Smolenaers, F., Mcgrath, M., & Gray, K. (2018). Non-contact sensor-based falls detection in residential aged care facilities: developing a real-life picture...Health Informatics Conference, Sydney Australia, 2018. *Studies in Health Technology & Informatics*, *25*, 233-238. doi:10.3233/978-1-61499-890-7-33

Burridge, J. H., Chong W. Lee, A., Turk, R., Stokes, M., Whitall, J., Vaidyanathan, R., & ... Yardley, L. (2017). Telehealth, wearable sensors, and the internet: Will they improve stroke outcomes through increased intensity of therapy, motivation, and adherence to rehabilitation programs? *Journal of Neurologic Physical Therapy, 41*, S32-S38. doi:10.1097/NPT.0000000000000183

Chaudhuri, S., Kneale, L., Le, T., Phelan, E., Rosenberg, D., Thompson, H., & Demiris, G. (2017). Older adults' perceptions of fall detection devices. *Journal of Applied Gerontology, 36*(8), 915-930. doi:10.1177/0733464815591211

Chaudhuri, S., Oudejans, D., Thompson, H. J., & Demiris, G. (2015). Real-world accuracy and use of a wearable fall detection device by older adults. *Journal of The American Geriatrics Society, 63*(11), 2415-2416. doi:10.1111/jgs.13804

Chaudhuri, S., Thompson, H., & Demiris, G. (2014). Fall detection devices and their use with older adults: A systematic review. *Journal of Geriatric Physical Therapy, 3*7(4), 178-196. doi:10.1519/JPT.0b013e3182abe779

Coahran, M., Hillier, L. M., Van Bussel, L., Black, E., Churchyard, R., Gutmanis, I., & ... Mihailidis, A. (2018). Automated fall detection technology in inpatient geriatric psychiatry: Nurses' perceptions and lessons learned. *Canadian Journal on Aging*, *38*(3), 245-260. doi:10.1017/S071498081800018

Dennerlein, J. T. (2015). The state of ergonomics for mobile computing technology. *Work*, 52(2), 269–277. https://doi-org.ezproxy2.library.arizona.edu/10.3233/WOR-152159

Effken, J. (2003). An organizing framework for nursing informatics research. *CIN: Computers, Informatics, Nursing*, *21*(6), 316-325.

Effken J. A. (2009). Overview: using the IROM to guide and evaluate research. Communicating Nursing Research, 42, 156. Retrieved from http://search.ebscohost.com.ezproxy4.library.arizona.edu/login.aspx?direct=true&db=rzh&AN=105055263&site=ehost-live

Feldwieser, F., Marchollek, M., Meis, M., Gietzelt, M., & Steinhagen-Thiessen, E. (2016). Acceptance of seniors towards automatic in-home fall detection devices. *Journal of Assistive Technologies*, *10*(4), 178-186. doi:10.1108/JAT-07-2015-0021

Fogg, B.G. (2010). Article: Thoughts on persuasive technology. *Persuasive Technology Laboratory at Stanford University*. Retrieved September 16, 2017 from http://captology.stanford.edu/resources/thoughts-on-persuasive-technology.html

Gazibara, T., Kurtagic, I., Kisic-Tepavcevic, D., Nurkovic, S., Kovacevic, N., Gazibara, T., & Pekmezovic, T. (2017). Falls, risk factors and fear of falling among persons older than 65 years of age. *Psychogeriatrics*, *17*(4), 215-223. doi:10.1111/psyg.12217

Godfrey, A., Hetherington, V., Shum, H., Bonato, P., Lovell, N., & Stuart, S. (2018). From A to Z: Wearable technology explained. *Maturitas*, *11*, 340-347. doi:10.1016/j.maturitas.2018.04.012

Great Call. (2018). *Great call: Feel safer at home or on the go*. Downloaded October 15, 2018 from https://www.greatcall.com/devices/lively-mobile-medical-alert-system

Hatamabadi, H. R., Sum, S., Tabatabaey, A., & Sabbaghi, M. (2016). Emergency department management of falls in the elderly: A clinical audit and suggestions for improvement. *International Emergency Nursing*, *24*, 2-8. https://doi-org.ezproxy3.library.arizona.edu/10.1016/j.ienj.2015.05.001

Hoaas, H., Andreassen, H. K., Lien, L. A., Hjalmarsen, A., & Zanaboni, P. (2016). Adherence and factors affecting satisfaction in long-term telerehabilitation for patients with chronic obstructive pulmonary disease: A mixed methods study. *BMC Medical Informatics & Decision Making*, 161-14. doi:10.1186/s12911-016-0264-9

Huber, L. & Watson, C. (2014). Technology: Education and training needs of older adults. *Educational Gerontology, 4*0(1), 16-25. https://doi-org.ezproxy4.library.arizona.edu/10.1080/03601277.2013.768064

Institute for Healthcare Improvement. (2019). Plan-do-study-act (PDSA) worksheet. Retrieved April 25, 2019 from http://www.ihi.org/resources/Pages/Tools/PlanDoStudyActWorksheet.aspx

Fletcher, J. & Jensen, R. (2015). Mobile health: Barriers to mobile phone use in the aging Population. *Online Journal of Nursing Informatics*, 19(3), 1-8 (8p).

Kirch, D. G. & Petelle, K. (2017). Addressing the physician shortage: The peril of ignoring demography. *JAMA: Journal of The American Medical Association*, *317*(19), 1947-1948. doi:10.1001/jama.2017.2714

Keller, S. & Kelvin, E. A. (Eds.) (2013). *Chapter 2: Organizing, displaying, and describing data*. In *Monroe's statistical methods for healthcare research* (6th ed.). Philadelphia, PA. Wolters Kluwer Health, Lippincott Williams & Wilkins.

Lapierre, N., N. Neubauer, A. Miguel-Cruz, A. Rios Rincon, L. Liu, and J. Rousseau. 2018. The state of knowledge on technologies and their use for fall detection: A scoping review. *International Journal of Medical Informatics*, *111*, 58-71.

Laxman, K., Banu Krishnan, S., & Dhillon, J. S. (2015). Barriers to adoption of consumer health informatics applications for health self-management. *Health Science Journal*, 9(5), 1-7 (7p).

Lipsitz, L. A., Tchalla, A. E., Iloputaife, I., Gagnon, M., Dole, K., Su, Z. Z., & Klickstein, L. (2016). Evaluation of an automated falls detection device in nursing home residents. *Journal of The American Geriatrics Society, 64*(2), 365-368. doi:10.1111/jgs.13708

Liu, S. W., Obermeyer, Z., Chang, Y., & Shankar, K. N. (2015). Frequency of ED revisits and death among older adults after a fall. *American Journal of Emergency Medicine, 33*(8), 1012-1018. doi:10.1016/j.ajem.2015.04.023

Marquis-Faulkes, F., McKenna, S., Newell, A., & Gregor, P. (2005). Gathering the requirements for a fall monitor using drama and video with older people. *Technology & Disability, 17*(4), 227-236.

Melnyk, B. & Fineout-Overholt, E. (2011). *Evidence-based practice nursing healthcare: A guide to best practice* (2nd ed.). Philadelphia PA: Wolters Kluwer health Lippincott Williams & Wilkins.

Moran, K., Burson, R., & Conrad, D. (Eds.) (2017). *The doctor of nursing practice scholarly project: A framework for success* (2nd ed.). Burlington, MA: Jones & Bartlett Learning, LLC, an Ascend learning company. Burlington, MA.

Nilsen, P. (2015). Making sense of implementation theories, models and frameworks. *Implementation Science*, *1*0(1), 53. doi:10.1186/s13012-015-0242-0

Nyman, S. R. & Victor, C. R. (2014). Use of personal call alarms among community-dwelling older people. *Ageing & Society*, *34*(1), 67-89. https://doi-org.ezproxy1.library.arizona.edu/10.1017/S0144686X12000803

Koninklijke Phillips, N. V. (2016). *Automatic fall detection: Auto alert quickly detects falls and connects to help*. Retrieved September 23, 2018 from https://www.lifeline.philips.com/medical-alert-systems/fall-detection.html

Polit, D. F. & Beck, C. T. (Eds.) (2017). *Nursing research: Generating and assessing evidence for nursing practic*e (10th ed.). Philadelphia, PA: Wolters Kluwer Health, Lippincott Williams & Wilkins.

Reed, P. G. (2011). The spiritual path of nursing knowledge. In. P. G. Reed & N. B. Crawford-Shearer. *Nursing knowledge and theory innovation: Advancing the science of practice.* New York, NY: Springer Publishing Company.

Research Gate. (2018). *Informatics research organizing (IRO) model.* Retrieved October 11, 2018 from https://www.researchgate.net/figure/Informatics-Research-Organizing-IRO-Model_fig2_265202465

Taylor-Piliae, R. E., Mohler, M. J., Najafi, B., & Coull, B. M. (2016). Objective fall risk detection in stroke survivors using wearable sensor technology: A feasibility study. *Topics in Stroke Rehabilitation, 23*(6), 393-399. doi:10.1179/1074935715Z.00000000059

Terry, A. J. (Ed.) (2015). *Clinical research for the doctor of nursing practice* (2nd ed.). Burlington, MA: Jones & Bartlett Learning, LLC, an Ascend Learning Company.

Toh, N., Pawlovich, J., & Grzybowski, S. (2016). Telehealth and patient-doctor relationships in rural and remote communities. *Canadian Family Physician*, 62(12), 961-963 3p.

U.S. Centers for Medicare & Medicaid Services. (2016). *Independence at home demonstration*. Baltimore, MD. Retrieved May 1, 2018 from https://innovation.cms.gov/initiatives/independence-at-home/

Williams, V., Victor, C. R., & McCrindle, R. (2013). It is always on your mind: Experiences and perceptions of falling of older people and their carers and the potential of a mobile falls detection device. *Current Gerontology & Geriatrics Research, 29,* 50-73. doi:2013/295073

Yen, P., Bakken, S., Yen, P., & Bakken, S. (2012). Review of health information technology usability study methodologies. *Journal of The American Medical Informatics Association*, 19(3), 413-422. doi:10.1136/amiajnl-2010-000020

Yildiz, B. S., Findikoglu, G., Alihanoglu, Y. I., Kilic, I. D., Evrengul, H., & Senol, H. (2018). How do patients understand safety for cardiac implantable devices? Importance of postintervention education. *Rehabilitation Research & Practice,* 1-9. https://doi-org.ezproxy4.library.arizona.edu/10.1155/2018/5689353

Yingjuan, C. & Marion, B. (2018). A hospital nursing adverse events reporting system project: An approach based on the systems development life cycle. *Studies in Health Technology & Informatics*, *24*, 513-551. doi:10.3233/978-1-61499-830-3-1351

Zaccagnnini, M. & Waud-White, K. (Eds.) (2014). *The doctor of nursing practice essentials: A new model for advanced practice nursing* (2nd ed.). Burlington, MA: Jones & Bartlett Learning, LLC, an Ascend Learning Company.